established a traffic data collection plan. The LTPP data collection protocol states that reasonably accurate estimates of annual loading rates can be computed from fairly small samples of data if the WIM equipment is well calibrated and the traffic pattern is fairly stable at the location. In particular, for most General Pavement Studies (GPS) LTPP recommends sampling load data of two days per year to produce ±50% load estimates within a 95% confidence interval [*Hallenbeck, 2010*]. Another study investigated the effect of different sampling scenarios on pavement performance by comparing percentage errors in pavement life predictions with respect to the predictions obtained with continuous WIM data [*Papagiannakis (b), 2006*]. The two sampling scenarios for the WIM data sets were one month per season and one week per season. The results showed that sampling one month per season produced a life prediction percentage error of 13.42% at a 95% confidence level compared to estimates produced by continuous traffic input. For the one week per season samples, the error was 17.33% with a 95% confidence level.

NCHRP Project 1-39 documents the effect of the length of the data collection period on the accuracy of pavement damage factors for short-duration WIM data [*NCHRP Project 1-39, 2005*]. The two data collection scenarios were: seven consecutive days and two consecutive weekdays. Short-duration WIM data estimates of annual average equivalent single-axle loads per vehicle (AAEPV) were compared to the estimates of AAEPV derived from annual WIM data. The results showed that using a WIM data sample of two consecutive weekdays produces moderate mean absolute percent error (MAPE) in the estimates of AAEPV (7.3% to 13% for different vehicle classes), while the use of seven consecutive days of data produces better MAPEs (5.7% to 10.1% for different vehicle classes). Li *et al*. has also investigated the effect of sampled WIM data on pavement design by examining five sampling schemes: 1 month, 3 months, 6 months, 9 months, and 12 months. They concluded that three random months of WIM data result in statistically sound traffic input for MEPDG [*Li et al., 2007*]. In a recent study, Hong *et al*. evaluated the effect of different sampling schemes on estimates of axle load distribution using three evaluation criteria: sum of absolute error of axle load distribution factor, errors in average ESALs per axle, and errors in pavement life estimates [*Hong et al., 2008*]. The sampling schemes involved different frequencies (month, quarter, and year) and different lengths of data collection (one day, two consecutive days, and one week). The results showed that sampled data from one day, two days, and one week per month, and two days and one week per quarter are sufficient to provide accurate traffic data for pavement design.

In summary, previous research has shown the effectiveness of several sampling schemes to generate estimates of traffic inputs for MEPDG. Some used relatively small samples assuming inherent randomness in truck traffic data. Some used damage analysis as a baseline comparison. Other research considered a relatively few sampling schemes. Thus, improvements can be achieved by increasing the sample repetitions, testing more sampling schemes, including the predictable seasonal variation (stability) of truck traffic, and establishing a baseline comparing the sampled estimates of ALDF to the ALDF from annual WIM data.

9.1.3 Overview

As discussed above North Carolina pavement performance is sensitive to NC site-specific ALDF and VCD, and this study focuses on axle load distributions only. The ALDF represents the frequency of individual load intervals, known as load bins, for four axle types: single, tandem, tridem, and quad. Among the four axle types, single and tandem axles are more frequent (57.7% and 41.9%) than tridem and quad axles (0.3%, and 0.1%). And tandem axles also have a larger effect on pavement performance (35% and 64%) than tridem and quad axles (both less than 1%) as demonstrated below by damage factor analysis that quantifies the effect of different axle types on pavement performance. Thus, it is justifiable to examine the effectiveness of different sampling schemes on the accuracy of single and tandem ALDFs. The proposed NC sampling scheme has different frequencies (annual,